

Amendments to the Specification:

Please replace the paragraph on page 1, lines 6 and 7, with the following rewritten paragraph:

61 ^{IND} This application is related to copending U.S. application serial number 09/080,322 to Andrew Senior, filed on May 15, 1998, for "Combined Fingerprint Acquisition and Control Device" and assigned to a common assignee herewith, now U.S. Patent No. 6,400,836. The disclosure of U.S. Patent No. 6,400,836 is incorporated herein by reference.

Please replace the paragraph on page 2, lines 17 to 24, with the following rewritten paragraph:

62 Pending application U.S. Patent No. 6,400,836 to Senior serial no. 09/080,322 employs the steps of viewing the fingerprint as an elliptical region, using this view to find rotation in the plane of the scanner, and finding the principle principal axes of the region. The contents of U.S. serial no. 09/080,322 are hereby incorporated by reference. However, it is has been found that when pressure is light, as when only the very tip of the finger is used, or when the finger is at the edge of the scanning area, the principal axis of the pixels does not correspond to the principal axis of the finger tip, as. As a result, the reliability of this the scanning method disclosed in U.S. Patent No. 6,400,836 could be improved.

This part is not claimed in the claims.

Please replace the paragraph on page 4, lines 23 and 24, with the following rewritten paragraph:

63 Figure 2a 2A is an illustration of a "tiled" fingerprint scanner using a row of small fingerprint scanners;

Please replace the paragraph beginning on page 2, line 25, and continuing to page 5, line 1, with the following rewritten paragraph:

b7x

Figure 2b 2B is an illustration of a "tiled" fingerprint scanner using a set of smaller fingerprint scanners, in a two-dimensional array;

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Please replace the paragraph on page 6, lines 23 to 18, with the following rewritten paragraph:

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The semiconductor scanners being smaller in size (less than half the size of a normal average finger), a large scan area can be achieved by tiling a set of small fingerprint scanners to form a large scanning area 130 as shown in Figures 2a 2A and 2b 2B. The small scanners can be tiled in either a one-dimensional array 270, as shown in Figure 2a 2A, or as a two-dimensional array 280 as shown in Figure 2b 2B.

Please replace the paragraph on page 9, lines 9 to 15, with the following rewritten paragraph:

b7c

Optionally, a Hough transform based alignment of two fingerprint minutia templates can be used as presented in the following reference and is incorporated in its entirety. In this case the regions of interest in a fingerprint image 303 are chosen by a fingerprint feature extraction algorithm. See, for example, N.K. Ratha, K. Karu, S. Chen, and A. Jain, "A Real-Time Matching System for Large Fingerprint Databases", IEEE Transactions on Pattern Analysis and Machine Intelligence *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 18, No. 8, August 1996, pp. 799-813.

Please replace the paragraph on page 10, lines 8 to 13, with the following rewritten paragraph:

b7
If the rotation and translation are to be estimated, the voting table will have three dimensions (x, y, theta) and any given translation calculated for an image area, will correspond to many triplets of values in the table. A vote is entered in each box in the voting table consistent with the translation measured. At the end, the box with the highest number of votes is chosen, and the translation, rotation parameters are read off.

Please replace the paragraph beginning on page 10, line 24, and continuing to page 11, line 1, with the following rewritten paragraph:

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The authentication process is broadly shown in the flow chart in Figure 4. At the start 401, the user is prompted 402 for authentication. If authentication is positive 403, the boot process is complete completed 404. However, if the authentication is negative, then the system cycles through the prompting steps 401 again until it is verified that three attempts 405 have been made to achieve authentication. After three attempts the computer is shut down 406.

Please replace the paragraph on page 11, lines 12 to 23, with the following rewritten paragraph:

b9
Now, suppose that a video sequence of a fingerprint has been recorded. The computer system can prompt the user to move his or her finger in a particular manner (e.g. "Move left", "press harder", "rotate counterclockwise", etc.). Such prompts can be verified by observing the derived parameters when a live user presents a finger to be scanned and makes the requested gesture. But for a simple replay attack, the image sequence is predetermined and cannot respond to prompts, and so exposed as a replay attack. In the case of several small fingerprint scanners as in Figure 2a 2A or 2b 2B, there are many other ways of achieving this step. For example, the user can touch the different tiles in a particular sequence and remember it as the password. This sequence of touches can be done using

b9 either a single finger or multiple fingers with the finger used for each touch also being part of the "password".

Please replace the paragraph beginning on page 11, line 24, and continuing to page 12, line 13, with the following rewritten paragraph:

b9 The inventive system combats replay attacks with the steps ~~shows~~ shown in the flow chart of Figure 5. Figure 5 is a flow diagram for the operation of validating a user by prompting the user for a fingerprint 501, and by requiring the user to make finger movements (on the scanner or by reapplication of the finger to the scanner) to prevent replay attacks. As can be ~~see~~ seen, the user is prompted for a fingerprint 501. After waiting for the fingerprint 502, the system determines if it matches the template 503. If the template is not matched then the user is rejected 504. If the template is matched, then the user is prompted for the finger movement 505. The movement can be chosen at random by the computer and the movement request will be unknown to the user until the time of request. After waiting for the user's movement 506, a determination is made as to whether the gesture matches the prompt 507. If not, the user is again rejected 504. Following step 507, a determination is made in step 508 as whether enough gestures were made. In some applications more than one gesture will be required. If enough gestures have not been made the system return to block 505 and prompt the user for another finger movement. Once enough gestures have been made the user is accepted as shown in block 509.
